Managing External Information in Manufacturing Firms: The Impact on Innovation Performance*

Johan Frishammar and Sven Åke Hörte

Drawing upon a sample of 206 medium-sized manufacturing firms, this article investigates the extent to which management of external information is associated with innovation performance. The overall purpose of the article is to examine whether or not those organizations that are better at managing external information are also those that are the better innovators. The research strategy used was a survey, and data were collected by means of mail questionnaires (with a 62.4% response rate). A multiple regression analysis was used for hypothesis testing. The results show that scanning the technological sector of the environment was positively associated with innovation performance, while scanning customers, suppliers, and competitors proved to be negatively correlated with innovation performance. Cross-functional integration in the form of collaboration also proved significantly correlated with innovation performance, while interaction showed no such relationship. Further, decision-making based on information from the industry environment correlated significantly with innovation performance. Research and managerial implications of these findings are presented and are discussed.

Introduction

The environment creates both opportunities and problems for organizations. Organizations depend on the environment for scarce resources (Pfeffer and Salancik, 1978) and often must cope with and adapt to changes in the environment. The environment affects organizational processes and decision-making perhaps more than any other factor (Daft, Sormunen, and Parks, 1988; Duncan, 1972). A process open to environmental influence, and central to business prosperity, is product innovation. An overview of the success/failure literature on new product development (NPD) (e.g., Cooper, 1994; Cooper and Kleinschmidt, 1987, 1995; Montoya-Weiss and Calantone, 1994; Rothwell, 1992) points to environmental information as one critical factor for successful NPD. On an overall level, the importance of managing external environmental information derives from the fact that organizational knowledge creation depends crucially upon the information processing capacities of the organization (Cohen and Levinthal, 1990; March and Simon, 1958).

This article examines the link between innovation performance and management (i.e., gathering, sharing, and using) of information, with a special focus on external information. This question is of great importance, since many firms with in-house product development active on a competitive market are crucially dependent on innovation. At the same time, information-processing activities such as scanning or market research are costly, and their outcomes are often uncertain. Specifically, this article aims to contribute to the literature in this area in the following ways. First, unlike the studies on market orientation and NPD (e.g., Atuahene-Gima, 1995, 1996; Narver, Slater, and...
various sources is vital to the success of a firm that
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managers aware of the need for change. Attempts to
gather information from the environment may make
managers aware of the disadvantages of their own
product lines but also can indicate changing customer
demands and buying patterns (Miller and Friesen,
1982).

The second argument suggests that, as organiza-
tions mature, they become more remote from external
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tiated externally, which suggests that the boundaries
of an organization must be permeable, at least from
the outside in, and that information gathering from
various sources is vital to the success of a firm that
depends on its own product development. For an ex-
ample, see Neely et al. (2001) or von Hippel (1988),
who suggest that innovative firms maintain close con-
tact with customers and suppliers in order to obtain
ideas. Therefore, after an original idea has been com-
mercialized, firms that wish to remain innovative will
need to continually acquire and analyze information
from the environment (Gupta, Raj, and Wilemon,
1985; Quinn and Cameron, 1983).

The starting point of the third argument lies in the
difference between the two terms "invention" and "inno-
vation." As stated by Garcia and Calantone (2002,
p. 112), an innovation is "an iterative process initiated
by the perception of a new market and/or new service
opportunity for a technology-based invention which
leads to development, production, and marketing
tasks striving for the commercial success of the in-
tvention." According to the current literature, it is im-
portant to elucidate that an invention does not
become an innovation until it has been processed
through production and marketing and is diffused
into the marketplace. Thus, a discovery that goes no
further than the laboratory remains an invention.

In order to transform an invention into an inno-
vation—and to diffuse it successfully—information
from various sectors of the external environment is
necessary. A firm must analyze current situations
and trends of a potential market for a new product (a new
invention). Without knowledge of the potential
market, a firm may waste resources in developing a
product for an unfavorable market (Mishra, Kim, and
Lee, 1996; Ottum and Moore, 1997). For example, a
firm may produce a product for which there is insuf-
ficient demand. The literature reviewed so far suggests
that external information is important for innovation
in firms. That is, successful innovation is largely de-
pendent on how external information is managed. The
information–innovation theme is further developed in
the next section of the article, comprising the frame of
reference.

Frame of Reference and Hypotheses

To monitor the external environment of organizations
involves collecting information. This activity is known
as "environmental scanning" and is defined as "the ac-
tivity of acquiring information" (Aguilar, 1967, p. 1).
There are different methods of scanning available to
an organization. A firm may use formal techniques
such as market research, a competitor analysis system

BIOPGRAPHICAL SKETCHES

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pany competitiveness.
(Porter, 1980), or a formalized intelligence-gathering system (Ashton and Stacey, 1995). A common characteristic of these is that activities can be planned, controlled, and executed by the management of a firm. Another option is to rely on more informal means such as gatekeepers. The latter have received a fair share of attention in NPD since people assuming the gatekeeper role can open “the gate” raised by differences in language, norms, values, and coding schemes inside and outside an organization (Allen, 1977; Allen and Cohen, 1969; Brown and Utterback, 1985; Tushman and Scanlan, 1981). That is, gatekeepers have the ability to gather and to understand external information but also the ability to translate and to make sense of it to their more internally oriented colleagues. Therefore, a gatekeeper is thought to provide a link between an organization/organizational unit and its environment. Irrespective of what method or combination of methods on which a firm relies, these information acquisition activities are the means by which managers perceive external events and trends (Hambrick, 1982). Such information acquisition and processing activities are believed to generate openness to external knowledge (Birkinshaw and Fey, 2000) but also to have a large impact on the process of innovation (Lozada and Calantone, 1996). In summary, environmental scanning spawns innovative ventures (Howell and Shea, 2001).

Environmental scanning provides information from different sectors of the environment. In order to discriminate between different environmental sectors, a hierarchical conception of firms’ external environment was employed for the present study. The article thus suggests a division\(^1\) into (1) competitive or industry environment and (2) general environment. The \textit{industry environment} comprises a firm or business unit and its competitors in the same industry. It is thought to consist of a particular set of competitive forces that establish both opportunities and threats and that may change due to the actions of competitors. As such, it represents a specific school of thought in environmental analysis with regard to what is fundamental and important. Porter (1980) uses the term \textit{competitive forces} to refer to buyers, suppliers, substitute products (or services), and potential industry entrants, as well as strategic groups of directly competing firms. Strategic moves by any of these can alter prevailing relationships and thereby can change the pattern of forces in a firm’s environment. It has been suggested that environmental change from this perspective occurs as a result of certain evolutionary processes that originate from both interaction among competitors and events in the general environment (e.g., product innovation, government policy). In either case, the effect is to erode the prevailing equilibrium of the underlying structural features of an industry. This sets the stage for the emergence of a new pattern of the competitive forces (Lenz and Engledow, 1986). Change is, however, not random. Rather, multiple scenarios exist for the development of organizational environments, and in order to track these changes it is proposed that organizations should gather information about their environments through the implementation of a formalized competitor analysis system (Porter, 1980).

Monitoring factors in the industry environment seem important for a firm’s innovation. For example, the gatekeepers in Macdonald and William’s (1994) study considered suppliers the most important source of information, followed by customers and competitors ranking third and fifth. Research in the area of market orientation has singled out two sources in the industry environment as very important for firms’ innovation: customers and competitors. Both Kohli and Jaworski (1990) and Slater and Narver (1994) argue that businesses with a strong market orientation are best suited for NPD success. Atuahene-Gima (1995) and Kahn (2001) found a positive relationship between market orientation and product development performance. Gatignon and Xuereb (1997) report a significant relationship between customer orientation and product innovation (in markets where demand is relatively uncertain). Lukas and Ferrell (2000) found that a greater emphasis on customer orientation increases the introduction of new-to-the-world products and reduces the number of me-too products launched by firms. There is, however, an opposite view whose claim is that information about certain industry-related factors (i.e., customers and competitors) leads to lower rather than higher innovation (e.g., Christensen and Bower, 1996). All organizations active in an industry characterized by competition face some kind of industry environment, however. It therefore seems necessary to actively engage in information gathering, since scanning these factors generally is considered important for firms’ innovation. Therefore, the first hypothesis states that

\(^1\) A third level, referred to as \textit{task environment}, can be identified (Dill, 1958). The task environment can be described as firm specific and is not considered in the present study.
H1: There is a positive association between scanning of the industry sector of the environment and innovation performance in organizations.

Everything of importance to an organization does not take place in the industry, however. An organization also must be alert to changes in the general environment (Fahey and Narayanan, 1986). Factors in the general environment influence all the industries within it and include social factors (e.g., demographics, life styles, social values of society), economic factors (e.g., economic development, interest rates), political factors (e.g., political processes, regulatory institutions), and technological factors (e.g., technological processes or advances, new products, processes, materials). For example, innovative firms have reported that investors and governments play a crucial role in the innovation process—the former by providing funding and the latter by influencing the firms’ choices with regard to standards (Neely et al., 2001).

Moreover, Abell (1978) argues convincingly that the nature of technological innovation and diffusion is such that most major innovations will originate outside a particular industry and not within it. Established competitors in an industry are usually challenged not by their known competitors within the industry but by organizations that base their approach on a technology developed outside that industry. To cope with this, Abell (1978) suggests that managers should increase their information-gathering activities in an attempt to improve decision-making.

Utterback (1996) also emphasizes that changes that revolutionize an organization’s business have a tendency to come from unexpected directions and tend to be viewed as disruptive. These include functional competition from new technologies often introduced by new firms or existing businesses entering a new market. The author suggests that organizations must adapt to environmental changes that are often beyond their control or influence and that require changes in products, policies, and structure. This presupposes a need to anticipate important environmental changes as well as an emphasis on the way in which organizations gather and analyze information about the environment (Utterback, 1996).

Yet another example is provided by Smircich and Stubbart (1985), who claim that outsiders often generate really novel products that invade an industry. The authors exemplify this with the Miller Brewing unit of Philip Morris and their introduction of light beer—a significant product innovation that tested the salient assumption that a light beer could not be sold. This example and others point to the importance of factors outside a specific focal industry for firms’ innovation. So far the discussion in this section has centered on major or radical innovations. Does that imply that factors in the general environment are not important for other types of innovation? While this is not necessarily the case, the present authors nevertheless have failed to locate anything in the literature to lend support to such an opinion. This is a question that needs closer attention. Thus, firms also should pay attention to the importance of factors outside the industry, and therefore it is hypothesized that

H2: There is a positive association between scanning of the general sector of the environment and innovation performance in organizations.

Gathering information from the environment is, however, not sufficient. Sharing information across functional areas is also vital for innovation. Because innovation is an iterative process of information-processing activities (e.g., Clark and Fujimoto, 1991), it requires input from members of various functions playing different roles. In accordance with the existing literature, the term integration will be used when referring to this dimension. Lawrence and Lorch (1986, p. 1) define integration as “the quality or state of collaboration that exists among departments that are required to achieve unity of effort by the demands of the environment.” In practice, integration means linking functionally specialized departments while preserving their individual orientations (Moenaert and Souder, 1990). For example, information transfer at the marketing–research and development (R&D) interface is crucial since these functions share responsibility for setting NPD goals, for identifying opportunities for product improvements, and for understanding customer requirements (Sherman, Souder, and Jenssen, 2000). However, many important activities in NPD (e.g., sourcing of components, prototype production, quality control) fall outside of marketing and R&D. It therefore has been suggested that an accurate representation of cross-functional relationships in NPD also must include manufacturing (Olsen et al., 2001; Song, Montoya-Weiss, and Schmidt, 1997).

To achieve integration between departments is problematic for many firms (Griffin and Hauser, 1996; Gupta and Wilemon, 1988; Moenaert et al.,
1994; Sherman, Souder, and Jenssen, 2000). Research by Souder (1988) on almost 300 NPD projects indicates that disharmony rather than integration characterizes many relationships between departments and functions. In essence, Souder’s (1988) findings indicate that high integration projects succeed, and low integration projects fail. Similar ideas have been expressed by Ottum and Moore (1997), who observe that information collected by one department is rarely shared with others. Thus, it is suggested that information sharing between functions and departments is an important activity that needs to be performed in addition to acquiring information via different scanning methods.

It has been suggested that integration is a two-dimensional construct representing both interaction and collaboration. Interaction represents the structural and formally coordinated activities between departments and includes routine meetings, planned teleconferencing, memoranda, and flow of standard documentation (Kahn, 1996). Collaboration represents the more unstructured, affective nature of interdepartmental relationships and stresses continuous relationships between departments as opposed to just transactions. Collaboration is defined as “an affective, volitional, mutual/shared process where two or more departments work together, have mutual understanding, have a common vision, share resources, and achieve collective goals” (Kahn, 1996, p. 139). Interaction and collaboration are both important elements of interdepartmental relationships. While interaction clearly addresses the issue of sharing and transferring information, collaboration is also a good approximation of such activities, since a high degree of collaboration presupposes an adequate flow of information between functions and departments.

In sum, different departments and functions need information from one another to accomplish their specific tasks. As integration between functions decreases, their ability to combine skills to develop and to produce successful products decreases, and the firm suffers (Griffin and Hauser, 1996). The transfer of information between functionally specialized departments is therefore “the major vehicle that allows the involved individuals to become integrated” (Moenaert and Souder, 1990, p. 98). Or, to paraphrase Rothwell (1992), organizations that are successful with regard to innovation emphasize information sharing across functions, thus ensuring that customer needs remain the focus of R&D activities. The third hypothesis therefore suggests that

H3: There is a positive association between integration and innovation performance in organizations.

Given that an organization gathers information about the environment through environmental scanning activities, and given that this information is communicated to and is shared between functions and departments, it is still necessary for this information to be used and evaluated by executives responsible for making key decisions (Miller and Friesen, 1982). As earlier research has shown, the fact that information is available is no guarantee that it is used (Cyert and March, 1963). Without delving too deeply into the field of organizational decision-making [for a short review, see, e.g., Saunders and Jones (1990)], one can agree with Choo (1996) that the end goal of environmental scanning should be to ensure better-informed decisions. In other words, an organization can generate information by means of scanning and then can disseminate it internally between functions and departments, but if it is not used, very little is accomplished. It is recommended therefore that collected and disseminated information should be considered when making decisions pertaining to innovative activities. Thus, it is hypothesized that decision-making based on environmental information is an important activity that needs to be performed in addition to information acquisition and sharing. Therefore, this article’s fourth and final hypothesis suggests that

H4: There is a positive association between decision-making based on environmental information and innovation performance in organizations.

Method

Data for the study were collected via a mail survey between October 2002 and January 2003. The target population, conceived of as a census/population rather than as a sample, comprised Swedish firms classified as manufacturers with 175–2,500 employees. The average firm had 493 employees and annual sales of €111.4 million. The purpose of controlling for size was to obtain firms large enough to have specialized functions (e.g., marketing, R&D) while still being sufficiently small so that a single respondent could be expected to have a satisfactory overview of operations. It also was checked whether the firms had in-house product development, a criterion necessary for hypothesis testing. The population represents a
cross-section of industries and in some cases also separate divisions of larger corporations.

Initially, the population consisted of 344 firms. After a first mailing wave, three reminders were sent out, and telephone calls were made to almost all firms that did not respond. After review, 14 firms were dropped from the population frame, thus leaving 330 firms. In total, 208 responses were received, and six of those reported missing values. Two of the six were dropped since the respondents failed to answer certain sections of the questionnaire—a commonly used approach when relatively few cases report this kind of problem (Hair et al., 1998). In the remaining four, where single items were left blank, a replacement procedure employing mean substitution was adopted. Thus, the actual number of responses was 206, or a response rate of 62.4%. Since it seems to be widely believed that top administrators provide the best information about environmental and organizational characteristics, the questionnaires were mailed to the chief executive officers of these firms. Despite the potential of errors due to position bias, the findings of Huber and Power (1985) lend support to the method of using single key informants. Their study found that when several respondents had different opinions about an issue, the average of their responses was less likely to be accurate than when using one key informant. Of those who responded to the survey, 84% were chief executive officers (CEOs); the remaining 16% were typically marketing or R&D managers.

Measures

When selecting variables for the study, a conceptual model known in the literature as the intelligence cycle provided guidelines (see, e.g., Ashton and Stacey, 1995 or Montgomery and Weinberg, 1979). The model describes information collection, dissemination, and use but also provides an outline of the relationships among these variables. In summary, the model stipulates that information must be both shared and used in addition to being collected. However, to use innovation performance as a dependent variable is not stipulated by this model, nor is the conceptualization of the environment presented here. The variables considered in the present study are innovation performance, scanning of the industry and the general environment sectors, integration, and decision-making. The variables were initially constructed as cumulative indexes with equal weight for all items included. Five-point Likert scales were used for all measurements, with the sole exception of innovation performance, which was measured on a seven-point scale. In order to test for dimensionality and reliability, an exploratory factor analysis was performed (principal components, with varimax rotation). A summary of this test, as well as descriptive statistics for each construct, is found in Table 1.

Innovation performance was measured using the three items suggested by Miller and Friesen (1982). High innovation performance means the existence of a strong emphasis on R&D, the introduction of many new products/services over time, and changes in products/services having been significant. Conversely, low innovation performance means the opposite. One item was changed; the respondents were asked about products or services instead of lines of products or services since the firms investigated were generally much smaller than those studied by Miller and Friesen (1982). Furthermore, Miller and Friesen did not give a clear definition of product innovation in their article. A definition combining those of Gopalakrishnan and Damanpour (1997) and Garcia and Calantone (2002) therefore was used in the mail survey (see Appendix A). From the point of view of construct validity, this method is questionable since it actually measures self-reports and therefore could be viewed as being subjective. Several earlier studies claim, however, that perceptual measures are highly correlated with objective measures of product innovation but also have the advantage of facilitating comparisons among firms in different industries (Ancona and Caldwell, 1992; Zahra, 1993; Zahra and Covin, 1993). With regard to the specific Miller and Friesen (1982) measure, Jennings and Young’s (1990) findings imply that this subjective measure of innovation can be used interchangeably with objective ones. Furthermore, this measure also has been validated by Kahn and Manopichetwattana (1989), who found a strong correlation between this perceptual measure and more objective measures of innovation.

Measuring scanning activity is difficult since executives scan in fragmented, informal, and ad hoc ways (Aguilar, 1967; Hambrick, 1982). When measuring the scanning of the industry environment and the scanning of the general environment, a method suggested by Hambrick (1981, 1982) that has found widespread acceptance was adopted. While adopting the

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2 Twelve firms lacked their own product development (they were subcontractors), one was bought up, and one was found to market only services and no products.
basic idea of the method, the items used in the original version had to be amended due to differences in environmental conceptualization. The method is built around two different submethods—referred to as the frequency method and the interest method. The frequency method, as used here, involved asking respondents how frequently they learned of events or trends in two sectors of the environment. The interest method involved asking executives to rate the extent to which they made a point of staying abreast of the two sectors of the environment. A total of 16 items were used—eight for scanning the industry environment and eight for scanning the general environment. Both scanning variables turned out to be more complex than initially assumed. Scanning of the industry environment split into (1) information about substitute products; and (2) information about customers, suppliers, and competitors. Scanning of the general environment, in turn, split into three different constructs: information about (1) political/economical factors; (2) demographical factors; and (3) technological factors.

Integration was measured using the guidelines provided by Kahn (1996). Nine items were used to measure interaction, of which four were slightly modified to reflect activities better, thus hopefully making more sense to the respondents. Another six items were used to measure the collaboration dimension, and thus a total of 15 items was used. The subdimension of interaction split into two separate dimensions: (1) personal interaction; and (2) impersonal interaction. Personal interaction represented activities such as telephone calls and participation in meetings, while impersonal interaction contained factors such as exchange of reports and written messages.

When measuring decision-making, or the extent to which the external information collected actually enters into the decision-making process in the area of innovative activities, initial inspiration was provided by Ottum and Moore (1997). While the basic idea of their method has been adapted, all items were made from scratch, since no previously used instrument that fitted the research purpose of the present study could be located. As expected, the decision-making variable consisted of two dimensions: (1) decision-making based on information about industry factors; and (2) decision-making based on information about general environment factors.

### Analysis and Research Findings

Since three of the constructs (both scanning variables and the integration variable) proved more complex than initially assumed, making sense of the correlations also became a somewhat more complex process. Table 2 shows the correlation matrix for all variables included in the article. To avoid potential problems with multicollinearity as indicated in Table 2, the hypotheses in the present study were tested by analyzing the outcome of a linear multiple regression equation.

### Table 1. Descriptive Statistics and Test of Reliability and Dimensionality

<table>
<thead>
<tr>
<th>Variables</th>
<th>Initial no. of items</th>
<th>Items remaining</th>
<th>Mean</th>
<th>Std.</th>
<th>Lowest Item-Total correlation</th>
<th>Lowest Item-Item correlation</th>
<th>Cronbach's Alpha</th>
<th>Eigenvalue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation Performance</td>
<td>3</td>
<td>3</td>
<td>3.98</td>
<td>1.24</td>
<td>0.60</td>
<td>0.51</td>
<td>0.79</td>
<td>2.10</td>
</tr>
<tr>
<td>Scanning of Industry Environment</td>
<td>6</td>
<td>3</td>
<td>3.99</td>
<td>0.62</td>
<td>0.44</td>
<td>0.32</td>
<td>0.66</td>
<td>2.94</td>
</tr>
<tr>
<td>Scanning of General Environment</td>
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<tr>
<td>Substitutes</td>
<td>2</td>
<td>2</td>
<td>2.79</td>
<td>0.83</td>
<td>0.53</td>
<td>0.53</td>
<td>0.70</td>
<td>1.28</td>
</tr>
<tr>
<td>Customers, Suppliers, and Competitors</td>
<td>6</td>
<td>3</td>
<td>3.99</td>
<td>0.62</td>
<td>0.44</td>
<td>0.32</td>
<td>0.66</td>
<td>2.94</td>
</tr>
<tr>
<td>Political/Economical Factors</td>
<td>4</td>
<td>3</td>
<td>2.99</td>
<td>0.82</td>
<td>0.49</td>
<td>0.41</td>
<td>0.75</td>
<td>3.16</td>
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<td>Demographical Factors</td>
<td>2</td>
<td>2</td>
<td>2.21</td>
<td>0.82</td>
<td>0.54</td>
<td>0.54</td>
<td>0.70</td>
<td>1.33</td>
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<tr>
<td>Technological Factors</td>
<td>2</td>
<td>2</td>
<td>3.44</td>
<td>0.72</td>
<td>0.46</td>
<td>0.46</td>
<td>0.62</td>
<td>1.06</td>
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<tr>
<td>Integration</td>
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<tr>
<td>Personal Interaction</td>
<td>4</td>
<td>4</td>
<td>4.14</td>
<td>0.62</td>
<td>0.49</td>
<td>0.29</td>
<td>0.75</td>
<td>1.17</td>
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<td>Impersonal Interaction</td>
<td>5</td>
<td>5</td>
<td>3.36</td>
<td>0.80</td>
<td>0.62</td>
<td>0.42</td>
<td>0.84</td>
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<tr>
<td>Collaboration</td>
<td>6</td>
<td>6</td>
<td>4.07</td>
<td>0.61</td>
<td>0.63</td>
<td>0.46</td>
<td>0.88</td>
<td>6.22</td>
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<tr>
<td>Decision-Making</td>
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<tr>
<td>Decision-Making Industry</td>
<td>3</td>
<td>3</td>
<td>3.98</td>
<td>0.90</td>
<td>0.62</td>
<td>0.58</td>
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<td>1.66</td>
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<td>Decision-Making General</td>
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<td>3</td>
<td>2.84</td>
<td>0.96</td>
<td>0.72</td>
<td>0.67</td>
<td>0.83</td>
<td>3.10</td>
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</table>
The results of this regression analysis are shown in Table 3.

Starting out, no support was found for H1. No significant correlation existed between scanning of substitutes on the one hand and innovation performance on the other ($\beta = .104$). Further, scanning of customers, suppliers, and competitors proved to be significantly negatively correlated with innovation performance ($\beta = -.128$). The results obtained when testing H2 were similar: scanning of political/economic factors as well as demographical factors showed no significant correlations with innovation performance ($\beta = -.084$ and $\beta = -.039$, respectively). Scanning of technological factors proved, however, to be strongly correlated with innovation performance ($\beta = .386$). H3 stated that there should be a positive association between integration on the one hand and innovation performance on the other; only partial support was found for this hypothesis. Personal interaction showed a positive yet insignificant correlation with innovation performance ($\beta = .016$), and the effect of impersonal interaction was negative yet insignificant ($\beta = -.043$). Collaboration proved, however, to be significantly positively correlated with innovation performance ($\beta = .145$). Finally, only one of the decision-making constructs correlated significantly with innovation performance. Making decisions based on information about industry factors (e.g., about competitors, suppliers) is significantly positively correlated with innovation performance ($\beta = .260$). Decision-making based on information about more general factors (e.g., economic development, technological factors) proved not to be significantly correlated with innovation performance ($\beta = .084$).

**Table 2. Correlation Matrix Built on Pearson Correlation ($N = 206$)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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<tbody>
<tr>
<td>1. Innovation Performance</td>
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</tr>
<tr>
<td>Scanning of Industry Environment</td>
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<td>.092</td>
<td>.217**</td>
<td>.188**</td>
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*Correlation significant at the 0.05 level (two-tailed).
**Correlation significant at the 0.01 level (two-tailed).

The results of this regression analysis are shown in Table 3.

Starting out, no support was found for H1. No significant correlation existed between scanning of substitutes on the one hand and innovation performance on the other ($\beta = .104$). Further, scanning of customers, suppliers, and competitors proved to be significantly negatively correlated with innovation performance ($\beta = -.128$). The results obtained when testing H2 were similar: scanning of political/economic factors as well as demographical factors showed no significant correlations with innovation performance ($\beta = -.084$ and $\beta = -.039$, respectively). Scanning of technological factors proved, however, to be strongly correlated with innovation performance ($\beta = .386$). H3 stated that there should be a positive association between integration on the one hand and innovation performance on the other; only partial support was found for this hypothesis. Personal interaction showed a positive yet insignificant correlation with innovation performance ($\beta = .016$), and the effect of impersonal interaction was negative yet insignificant ($\beta = -.043$). Collaboration proved, however, to be significantly positively correlated with innovation performance ($\beta = .145$). Finally, only one of the decision-making constructs correlated significantly with innovation performance. Making decisions based on information about industry factors (e.g., about competitors, suppliers) is significantly positively correlated with innovation performance ($\beta = .260$). Decision-making based on information about more general factors (e.g., economic development, technological factors) proved not to be significantly correlated with innovation performance ($\beta = .084$).

**Table 3. Standardized Coefficient Estimates. Dependent Variable: Innovation Performance**

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<th>Independent Variables</th>
<th>Std. Coefficient</th>
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<td>$N$</td>
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* $p < .10$.
** $p < .05$.
*** $p < .001$.

**Discussion**

At a first glance, the results of testing H1 seem counterintuitive. The importance of scanning customers,
suppliers, and competitors is firmly rooted in the field of industrial organization, as well as in the NPD literature and also (to a large extent) in the marketing literature. A first plausible explanation for these findings is found, however, in the research area of market orientation. Some authors in this area claim that market orientation leads to commonality and bland new products since customer and competitor information constrains innovative thinking (Bennett and Cooper, 1981; Christensen and Bower, 1996; Lawton and Parasuraman, 1980; Trott, 2001). The underlying premise is that information about customer opinions are restricted to what is familiar to the customers—to products they can relate to. Furthermore, customers neither know what is technologically possible nor have full information about the latest market trends. Monitoring competitors is not thought to give any advantage either—adopting competitors’ ideas and technology is likely to lead to the development of “me-too” products. Atuahene-Gima (1996) partially supports this view and presents evidence that market orientation has a significant negative impact on product newness. In a study of 300 divisions, Moorman (1995) found that market information acquisition was not related to NPD performance. There is, of course, a counterargument: information about customer needs and competitors are central to innovation success (c.f. Gatignon and Xuereb, 1997; Kahn, 2001; Kohli and Jaworski, 1990; Lukas and Ferrell, 2000; Slater and Narver, 1994).

A second plausible explanation for the lack of significant correlations between most scanning constructs and innovation performance is that carrying out an activity such as environmental scanning is no guarantee that the substance of that activity has been fully appreciated. As Brown and Ennew (1995) suggest, the form of best practice may be followed, while the content is largely ignored. Observing actions and motives in detail with survey data is difficult and awkward, however, and sorting out correct explanations from incorrect ones becomes troublesome. It seems safe to state that more research in this area is needed, especially in the form of in-depth case studies or studies of ethnographic design.

Further, political–economical factors as well as demographical factors appeared much less important than expected. Perhaps this kind of information does not add much to firms’ innovation performance. One can imagine that this kind of information is more broad and general, and since resources and time for scanning activities are scarce, firms might choose to devote their attention to factors that affect their operations more directly (e.g., monitoring technological changes). Perhaps political–economical factors are more important in a context where the institutional environment is much more turbulent (as in many developing countries), and perhaps demographic information is more important when the activities take place on an volatile market characterized by constantly changing customer preferences, for example in fast moving consumer goods. This is a plausible explanation, although truly speculative, and evidence to back it up is not available.

Furthermore, an obvious interpretation of testing H2 is that staying ahead of technological development is crucial for firms relying on their own product development. The importance of monitoring technological factors has been established in previous studies (e.g., Ashton and Stacey, 1995; Clemons, 1997). Several motives contribute to explaining the importance of scanning the technological sector of the environment. First, the globalization of technological development forces firms to pay special attention to this area. Second, the general trend toward using external sources of technology makes systematic scanning of the technological environment necessary. Third, the growing complexity of the technological development also points to the importance of scanning this sector. And finally, keener competition often increases the pressure on R&D to improve its effectiveness. For a deeper and more complete discussion, see, for example, Lichtenthaler (2004).

The results on integration support earlier research findings (e.g., regarding the importance of collaboration). Fisher, Maltz, and Jaworski (1997); Kahn (1996, 2001); and Maltz and Kohli (1996) all present empirical support for collaboration being more important than interaction for enhancing NPD performance. The results further parallel the findings on interaction: Kahn (1996) found no significant effects of interaction on NPD performance (even if Kahn’s post hoc analysis showed that a few elements of the interaction scale correlated positively). Thus, the present study’s results suggest that neither of the two interaction constructs contribute to increasing innovation performance. This result points to the importance of personal communication between functions and departments for increasing innovation performance. Collaboration—an unstructured, volitional, and affective process—seems to make a difference, while interaction—a more structured one—does not.
Finally, using information about factors in the industry environment seems important for innovation performance. Ottum and Moore (1997) remind us that if information is not used, gathering and sharing do not matter. It seems fair to say that if information is not used in addition to being acquired and shared, innovation performance resulting from such information is not possible.

Conclusions and Implications

Overall, this study indicates that a positive relationship exists between scanning of technological factors and innovation performance. The findings further suggest that collaboration enhances innovation performance, as does using information about industry related factors when making decisions pertaining to innovative activities. Overall, the results indicate that managing (i.e., gathering, sharing, and using) external information is one important factor to consider when planning for innovation (although all types of information are not equal in terms of importance). Since environments change over time (Child, 1972; Pfeffer and Salancik, 1978; Porter, 1980), the present study’s results support the idea that monitoring these changes will pay off in terms of increased innovation performance. Technological factors seem to be of special importance here, and managers of firms with in-house product development are strongly advised to pay special attention to this area.

Furthermore, some earlier research suggests that scanning customers and competitors leads to lower rather than higher NPD performance—findings confirmed in this article. These results should not be interpreted, however, as customers or competitors being unimportant. Managers are likely to benefit greatly from closely monitoring these important others. Managers therefore may be advised to track and monitor changes in customer needs and wants as well as the actions of competitors, while keeping in mind that although information about these issues might be of great value to other parts of their operations, they should not be considered primary sources of innovation.

With regard to integration, the message sends a clear signal to managers involved with NPD: facilitate and encourage collaborative work between functions and departments in the innovation process. As Griffin and Hauser (1996) show, the evidence is strong across different methodologies that cooperation enhances success. The present study’s results suggest that managers need specifically to encourage personal communication and information exchange in the form of collaboration. Lack of communication is one of the most significant barriers to integration (e.g., Gupta, Raj, and Wilemon, 1985), and the results of the present study point to one obvious strategy for addressing that problem: invest resources in and encourage personal communication between functions and departments during the NPD process. It is suggested, therefore, that managers need to carefully evaluate and consider the different integrating mechanisms available (e.g., goal setting, task forces, integrating roles) for the criteria of personal communication. As earlier research in this area has shown, the choice of specific mechanisms to use depends on the specific strategy and circumstances of the firm and other contingency factors (Galbraith, 1973; Griffin and Hauser, 1996; Moenaert and Souder, 1990). Managers and other readers interested in this area are referred to these three pieces of literature for a more detailed discussion of what mechanisms might be appropriate and under what conditions.

Further, the results also may be interpreted as pointing to the importance of gatekeepers. Since gatekeepers are strongly linked to internal colleagues (Tushman and Katz, 1980), are described as key communicators (Davis and Wilkof, 1988), and often prefer oral sources of information (Allen, 1977; Hauschildt and Schewe, 2000; Tushman, 1979), they are likely to contribute to increasing the level of collaboration in a unit or organization. Thus, gatekeepers may help to close or to reduce information deficits on the part of other individuals (Ancona and Caldwell, 1992) as well as to facilitate cooperative relationships (Fritsch and Lukas, 2001). Therefore, recognition, reward, and promotion of these individuals should be a priority for management. A further benefit of gatekeepers, which traces to the findings of Allen (1977), is that they are particularly useful in securing technological information. This kind of information seems especially important for increasing innovation performance according to the results of this research.

Finally, it is important to elucidate that information needs to be used when making decisions. If information is not used, collection and dissemination are expensive and useless activities. To use environmental information seems especially important in so called “nonprogrammed” decision-making. According to Miller, Hickson, and Wilson (1996), such decisions are unfamiliar, to some extent are novel,
and have not been encountered in quite the same way before. They therefore present a special challenge to managers, since there are no well-trodden paths to follow. Nonprogrammed decisions appear regularly in NPD, since the heart of that activity implies creating something new. Although intuitive decision-making has been found to correlate positively with performance in unstable environments (Khatri and Ng, 2000), managers are advised to consider available information about industry-related factors carefully, in particular when involved in nonprogrammed decision-making situations.

Limitations and Future Research

The findings in this study should be interpreted with caution for a couple of reasons. First, the variables considered in the study concern information aspects only; many other variables have an impact on innovation performance in firms. Spillovers (Blind and Grupp, 1999; Hörte, 2004) and joint R&D (Brenner, 2001) are two (of many) variables potentially relevant. That is, all hypotheses tested here are implicitly governed by ceteris paribus assumptions. Second, since the data is cross-sectional, it is difficult to ascertain whether being skillful at managing information invariably leads to increased innovation performance. One could visualize a reverse direction of causality—that is, that more innovative firms have excess resources to spend on managing information. Future studies with a longitudinal design may shed light on this question. Third, one key feature of innovation—the fact that it is a process—is taken as given in this study. Failure to discuss this fact more deeply does not reflect a judgment that this is irrelevant or uninteresting. Rather, it was necessary for hypothesis testing.

Finally, understanding how firms’ management of external information affects innovation performance may be enhanced by additional research. One approach would be to examine differences in how “more” and “less” innovative firms manage external information in NPD processes. As stated by Hart, Tzokas, and Saren (1999), there is little empirical research that has examined what information is required, when it is required, and how it can be used during the various phases of the NPD process. Preferably, such a study should be conducted by employing a case-study approach. Case-study research could also aid in understanding how and why customer and competitor information affect innovation performance the way it does. Furthermore, to collect data over time with a longitudinal design also would be valuable.

References


Appendix. Operational Measures

1. Innovation Performance

By a new product/service innovation we mean one that is new to the firm, new to the market, or new to the industry and that is introduced for the benefit of customers or clients outside of your firm.

Please consider the following paired statement with regard to product/service innovation, and circle the number that is most accurate for your firm:

There is a strong emphasis on the marketing of true and tried products or services. 1 to 7 There exists a very strong emphasis on R&D, technological leadership, and innovations.

How many new products or services has your firm marketed in the past 5 years? Please exclude mere minor variations.

No new products or services in the past 5 years. 1 to 7 Hundreds of products or services in the past 5 years.

Consider also the following statement, and circle the option that best suits your firm.

Changes in products/services have been mostly of a minor nature (e.g., putting in towel with the soap). 1 to 7 Changes in products/services have usually been dramatic (e.g., changing from mechanical to electric calculators).

2. Scanning of Industry Environment

Listed below are 4 types of external events/trends or factors potentially affecting your organization. Please rate the approximate frequency with which each type of information comes to your firm’s attention.

Information about . . .

1 Customers of your organization
2 Suppliers to your organization
3 Competitors
4 Substitute products

(Response format: 1 = once a year or less; 5 = once a day or more)

Listed below are the same 4 types of external events/trends or factors that were described above. Please rate the extent to which your firm makes a point of staying abreast of these various trends/factors.

Information about . . .

1 Customers of your organization
2 Suppliers to your organization
3 Competitors
4 Substitute products

(Response format: 1 = We generally do not try to stay abreast of this type of information; 5 = We try to know all there is to know about this type of information).
3. Scanning of General Environment

Listed below are 4 types of external events/trends or factors potentially affecting your organization. Please rate the approximate frequency with which each type of information comes to your firm's attention.

Information about . . .

1. Demographics (life styles, social values of society)
2. Economic factors [interest rate, gross domestic product (GDP), etc.]
3. Political factors (new laws, regulations, and policies)
4. Technological factors (new products, processes, materials)

(Response format: 1 = once a year or less; 5 = once a day or more)

Listed below are the same 4 types of external events/trends or factors that were described above. Please rate the extent to which your firm makes a point of staying abreast of these various trends/factors.

Information about . . .

1. Demographics (life styles, social values of society)
2. Economic factors (interest rate, GDP, etc.)
3. Political factors (new laws, regulations, and policies)
4. Technological factors (new products, processes, materials)

(Response format: 1 = We generally do not try to stay abreast of this type of information; 5 = We try to know all there is to know about this type of information)

4. Integration

When developing new products or services, to what degree do the departments and/or functions of marketing, production, and R&D within your firm interact with each other with regard to the below activities?

1. Participation in meetings
2. Participation in committees/task forces
3. Phone conversations
4. Exchange of mail
5. Exchange of electronic mail
6. Exchange of forms
7. Exchange of reports
8. Exchange of memorandums
9. Exchange of FAX materials
10. Achieve goals collectively
11. Work for a mutual understanding
12. Informally work together
13. Share ideas, information, and/or resources
14. Share the same vision for the company
15. Work together as a team

(Response format: 1 = never; 2 = seldom; 3 = occasionally; 4 = often; 5 = quite frequently)

5. Decision-Making

Information collected from the industry environment (e.g., information about customers, suppliers, competitors, substitute products) is extremely important when:

(a) We set the actual design specifications for new products/services at our firm.
(b) We make decisions on developing new products/services at our firm.
(c) New products/services are introduced into the market by our firm.
Information collected from the general environment (e.g., information about demographics; life styles; economic, political, and technological factors) is extremely important when:

(a) We set the actual design specifications for new products/services at our firm.
(b) We make decisions on developing new products/services at our firm.
(c) New products/services are introduced into the market by our firm.

(Response format: 1 to 5)